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PHOTOSENSITIVE RECORDING ELEMENTS, PROCESSES FOR THEIR PRODUCTION AND FURTHER PROCESSING AS WELL AS DEVICES FOR CARRYING OUT THESE PROCESSES

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PHOTOSENSITIVE RECORDING ELEMENTS, PROCESSES FOR THEIR PRODUCTION AND FURTHER PROCESSING AS WELL AS DEVICES FOR CARRYING OUT THESE PROCESSES

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The subject matter of this invention is a new photosensitive recording element and new /2*
processes for their production and further processing to produce printing plates and photoresists. The subject matter of this invention also concerns a new device which is used to carry out the new production and processing procedures. In addition, the subject matter of this invention concerns the novel use of toners of the type used in electrophotography, inks of the type used in ink-jet printers, and pigments and/or mixtures of pigments and binders of the type used in thermal transfer printers and recently also in ink-jet printers, and the application of the associated processes for the production of the new photosensitive recording elements. Photosensitive recording elements (A, B, C) which serve the production for printing plates and photoresists and which comprise

A) a dimensionally stable carrier,

* [Editor's note: Numbers in the right margin represent pagination in the original foreign language text.]

B) a negative-producing or a positive-producing photosensitive recording layer (B1) or (B2), and

C) an optically transparent cover layer which contains a minimum of one polymer which forms films that are resistant to tearing have been known for a long time (see, for example, EP-A 03 16 618).

Generally, these photosensitive recording elements (A, B, C) are exposed to actinic light that travels through an image mask (D) which has been placed on top of the recording element and are subsequently developed with an appropriate developing solvent. In the course of this development, the cover layer (C) and the unexposed areas (negative-producing recording layer B1) or the exposed areas (positive-producing recording layer B2) are rinsed off. Photosensitive recording elements with a dimensionally stable carrier (A) and a photosensitive recording layer (B), the surface of which is covered with a relief-like pattern of uncoated and coated areas, are known from DE-A-26 38 710. In this case, the coated surface areas consist substantially of a polymer which is not sensitive to light and which is washed off during the development of the photosensitive recording elements (A, B) which were exposed to light, and of a light-absorbing means which is absorbed within the same wavelength range as the photosensitive recording layer (B). The relief-like pattern, however, is not an image mask which can serve to expose the photosensitive recording layer (B) of the photosensitive recording element to light. The relief-like pattern is only able to improve the contact between the photosensitive recording element and the conventional image mask.

A photosensitive recording element (A,B,D') with a dimensionally stable carrier (A), a photosensitive recording layer (B), and an image mask (D) which is directly superimposed onto the surface of the photosensitive recording layer (B) is known from DE-A-21 49 055. This photosensitive recording element (A, B ,D') is prepared by applying a layer consisting of a fine-particle crystal suspension of a photosensitive diacetylene compound in a polymer binder onto the surface of its photosensitive recording layer (B). It is important to ensure that the

composition of the photosensitive recording layer (B) is such that it is substantially insensitive to actinic light of a wavelength λ <320 nm. Subsequently, a conventional picture or photomask or a negative pattern is applied to the layer which contains the diacetylene compound; thereafter, this layer is exposed to actinic light of a wavelength of λ <320 nm, thereby producing exposed areas in this layer. These exposed areas contains polymer acetylenes which absorb 90% or more of the actinic light of a wavelength λ of 320 and 450 nm, which means that they are substantially opaque to actinic light of this wavelength. The unexposed areas of the layer in which the diacetylene compound is still present, on the other hand, remain transparent to actinic light of a wavelength λ between 320 and 450 nm. Thus, this exposed layer constitutes an image mask (D') through which the photosensitive recording layer (B) below can be exposed to actinic light of a wavelength λbetween 320 and 450 nm, thereby producing a pattern. Subsequently, both the image mask (D') and the unexposed surface areas of the recording layer (B) which was exposed so as to produce a pattern can be rinsed off with a developing solvent. The disadvantage of this process is that the image mask (D') which is directly superimposed onto the surface of the photosensitive recording layer (B) has to be produced by means of a conventional photomask or a negative pattern.

In addition, the recording element above requires the use of highly shortwave ultraviolet actinic light, which raises safety questions and is therefore a considerable drawback.

Another photosensitive recording element which contains a dimensionally stable carrier (A), an image mask (D) which is directly superimposed onto the surface of the photosensitive recording layer (B) is known from the article "Nyloprint® BASF, Nyloprint relief printing, the printing technique of the eighties and nineties. Can the Nyloprint relief printing plate be attached to modern data transmission systems? Is it possible to produce photopolymer relief printing plates without film?" in the special issue of the IFRA Expo 80, special edition, pages 5 and 6 of the Neuen Züricher Zeitung, Volume 201. Although it is possible to produce the image mask (D) of this well-known photosensitive recording element from a photopolymerizable masked layer through exposure to a computer-controlled UV laser light source and by subsequently rinsing it with a developing solution, the UV laser light sources that can be used for this purpose are

expensive and raise safety issues. In addition, the production of printing plates and photoresists /3 from this photosensitive recording element requires two rinsing steps, which is another drawback.

All of these recording elements have one common feature: none of them contains a cover layer (C), which means that the atmospheric oxygen is able to invade the recording layer (B), which can be of considerable disadvantage because of the oxygen's regulating effect.

The use of computer-controlled ink-jet printers for the production of proofs, the size and color of which correspond to the final print, is known, for example, from the article by Oliver Bruns, "Proofs from digital data: the ink-jet printer Iris 3024 in the response system by Scitex," in Deutscher Drucker, No. 36/November 9, 1989, pages w10 to w11. This article proposes to use ink-jet printer directly for the production of a photosensitive recording element with a dimensionally-stable carrier (A), a photosensitive recording layer (B), a cover layer (C), and an image mask (D) which is directly superimposed onto the surface of the photosensitive recording layer (B).

US-A-37 45 586 divulges a process which can be called "distillation printing." This process uses a thin film, one surface of which is coated with ink. The uncoated surface of this film is exposed to a laser light source so as to produce a specific pattern, in the course of which it is heated to a temperature that is sufficiently high to ensure that the ink in the exposed areas of the film is transferred to a different surface which is located at a certain distance from this film. This different surface may be a printing plate, and the transferred inks may be lithographic inks, thus making it possible to use the element resulting from the ink transfer directly in offset printing. Furthermore, this process can also be used for the production of masks for microchips. In this case, the photoresist material is selectively transferred to the carrier material of the mask.

Subsequently, the mask can be produced by means of conventional photoetching techniques. Other details are not divulged in US-A-37 45 586. In particular, the production of photosensitive recording elements (A, B, C, D) for the production of printing plates is not addressed. A process to some extent similar to that described in US-A-37 45 586 is known from DE-A-35 07 418. In this process, one or several vaporizable and/or meltable substances are

transferred from a film onto a plate by means of a computer-controlled thermal head. In this context, the use of an aluminum plate, such as is normally used to produce offset printing plates, is the most direct way to obtain a printable offset printing plate without intervening photomechanical steps. The drawback is that this printing plate has a very limited service life.

Also known is the use of toners, such as are generally used in electrophotography, for the production of image mask films (see DE-A-30 46 877). To produce these image masks, a polyester film is coated with a thin, slightly sticky, thermally or photochemically cross-linkable coating. In addition, a toner image consisting of toner particles is produced by substantially known means on the surface of an electrophotographic recording element (E) by means of a charge with a high-voltage discharge corona, exposure to actinic light so as to produce an image, and toner application. By allowing the sticky surface of the film to come into direct and intimate contact with toner image, the toner particles are transferred to the film. Subsequently, the thermally or photochemically cross-linkable layer on the film is cross-linked, which results in a picture mask free from adhesive material, which can be used as a photomask or a negative pattern for the production of printing plates and photoresists from photosensitive recording elements (A, B) using conventional and well-known techniques. DE-A-30 46 877 does not propose to transfer the toner image on the electrophotographic recording element (E) directly to a photosensitive recording element (A, B, C).

GB-A-20 82 976 proposes a process for the production of an offset printing plate in which inks are applied to photosensitive or non-photosensitive resin layers so as to produce an image. The photosensitive resin layers may be positive- or negative-producing resin layers. The inks applied in certain pattern to the surface, however, do not constitute image masks (D) for exposure to actinic light but ensure that the surface areas below are not washed off during the developing process. In cases in which negative-producing photosensitive resin layers are used, the surface areas protected by the inks can be cured with actinic light after the unprotected surface areas have been washed off, i.e., the inks must be transparent to actinic light. If, on the other hand, positive-producing resin layers are used, their entire surface is exposed to actinic light prior to the

developing step, thus solubilizing the resin layer. The ink applied in certain patterns to the surface subsequently ensures that the surface areas below the fully exposed resin layer are not washed off during the developing step. In all cases, the inks remain intact on the image areas.

Until now, the transfer of picture information onto photosensitive recording elements (A, B, C) which serve to produce printing plates or photoresists was almost exclusively accomplished by means of so-called contact exposure via a positive or negative film pattern which is produced by means of methods conventionally used in the reproduction process. The preparation of such an exposure pattern or image mask (D) in a reprographic laboratory and its proper storage for repeat orders, however, is time- and cost-intensive. To ensure a perfect transfer of such an exposure pattern or image mask (D) with the picture information to the photosensitive recording element (A, B, C), an intimate contact between the image mask (D) and the photosensitive recording element (A, B, C) must be ensured. So far, this has been accomplished through the use of a so-called vacuum table and a cover film. By means of suction, the image mask (D) and the cover film are tightly attached to the surface of the photosensitive recording element (A, B, C). For this purpose, the surface of the cover film must be roughened to make it possible for the air located between the film and the image mask (D) to be removed [by suction]. When roughened, however, the cover film generates undesirable dispersed light which prolongs the exposure time considerably. But apart from that, the sizes and shapes [of the printing plates or photoresists] are limited and cannot be exceeded since it is not possible to design randomly sized vacuum tables.

To produce especially large-surface printing plates or photoresists, correspondingly large positive or negative film patterns or image masks (D) are required. Generally, these relatively large film formats are assembled by gluing individual images together. Image masks (D) assembled in this manner, however, cannot be used for the production of gravure plates from photosensitive recording elements (A, B, C) since the edges of the individual images are visible on the printed impression of the gravure plates and therefore appear on the final print. Thus, very large film formats without cut edges are required, which entails considerably higher costs in the reprographic laboratory than normally encountered in the course of cutting and gluing processes.

The requirement in conventional transfer processes to ensure an intimate contact of the image mask (D) with the surface of the photosensitive recording element (A, B, C) raises other problems: if the surface of the photosensitive recording element (A, B, C) is sticky in the slightest and/or if the image mask (D) has an especially smooth surface, it is, on the one hand, almost impossible to completely vacuum out the air between the image mask (D) and the surface of the photosensitive recording element (A, B, C), which prolongs the contact time to an intolerable extent, and on the other hand, there is the risk that, following the contact between the image mask (D) and the photosensitive recording element (A, B, C), the image mask (D) can no longer be removed from the surface of the recording element. This requires the use of roughened surfaces, which, however, generate even more diffused light than is generally present to begin with.

In addition, an exposure in vacuo to produce a certain pattern cannot be used for cylinder-shaped photosensitive recording elements (A, B, C) which serve to produce continuously coated printing rollers. To produce such continuously coated printing rollers made of cylinder-shaped photosensitive recording elements (A, B, C), the image masks (D) must be pressed onto the photosensitive recording element (A, B, C) by means of a transparent film, which covers approximately one tenth of the periphery of the cylinder, and forwarded. In the course of this, air may be trapped between the image mask (D) and the surface of the photosensitive recording element (A, B, C), which interferes with an accurate transfer of the picture information. Again, care must be taken that the surface of the cylinder-shaped photosensitive recording element (A, B, C) is free from adhesive.

Yet, certain means for transferring picture information directly and without the use of an additional positive or negative film pattern, i.e., with an image mask (D), to recording elements which serve to produce printing plates and photoresists are already available. For example, in the production of gravure plates, information is transferred by means of gravure directly from the computer to the metal printing roller. In most cases, the processes known so far for transferring picture information from the computer to the plate ("computer-to-plate" technique) lead to unsatisfactory results as far as photosensitive recording elements (A, B, C) are concerned.

It is therefore the objective of this invention to find novel computer-controlled processes, by means of which picture information can be transferred to photosensitive recording elements (A, B, C), which serve to produce gravure, offset, relief, and flexographic printing plates and of photoresists, without the present state-of-the-art disadvantages. In addition, this computer-controlled transfer of picture information will be accomplished by producing an image mask (D) on the surface of the photosensitive recording elements (A, B, C), through which the photosensitive recording elements (A, B, C) can be exposed directly to actinic light, without the need of removing the adhesive from the surface of the recording elements and without the formation of diffused light. It is also the objective of this invention to define new photosensitive recording elements (A, B, C, D), on the surface of which an image mask (D) is present; thus, all that is required prior to developing these photosensitive recording elements in the reprographic laboratory is to expose the entire surface of these elements to actinic light. Another objective of this invention is to find new processes for the production of gravure, offset, relief, and flexographic printing plates and of photoresists which no longer have the present state-of-art drawbacks. And finally, an objective of this invention is to design a new device by means of which the new processes can be carried out especially rapidly and reliably.

Surprisingly, it was possible to solve these problems by producing an image mask (D) on the surface of the cover layer (C) of a photosensitive recording element (A, B, C) sing toners of the type used in electrophotography, inks of the type used in ink-jet printing, or pigments and/or mixtures of pigments and binders of the type used in thermal transfer printing. With respect to the present state of technology, it was surprising to discover that, using toners, inks, or pigments and/or mixtures of pigments and binders, it was possible to produce new photosensitive recording elements (A, B, C, D) which lead to excellent gravure, offset, relief, and flexographic printing plates and photoresists.

Thus, the subject matter of this invention concerns a recording element which is sensitive to ultraviolet and/or visible actinic light and which contains

A) a dimensionally stable carrier,

B) a negative-producing or a positive-producing photosensitive recording layer (B1) or (B2), and

C) an optically transparent cover layer which contains a minimum of one polymer that forms films which are resistant to tearing, and

D) an image mask which is superimposed directly onto the surface of the cover layer (C), with the photosensitive recording element (A, B, C, D) being characterized by the fact that the image mask (D) constitutes a relief-like pattern of coated areas (D1) and uncoated areas (D2), with the coated areas (D1) being substantially opaque to the actinic light to be used.

A preferred embodiment of the photosensitive recording element (A, B, C, D) is characterized by the fact that the coated areas (D1) of the relief-like pattern or image mask (D) consist of droplets of liquid or of solid particles which have been transferred to the surface of the cover layer (C).

The subject matter of this invention also includes processes for the production of the novel recording element (A, B, C, D) which is sensitive to ultraviolet and/or visible actinic light as well as new processes for further processing of this photosensitive recording element to produce gravure, offset, relief, and flexographic printing plates and photoresists.

Another subject matter of this invention is a new device for carrying out the new production processes and processing procedures mentioned above.

For the sake of brevity, the new recording element (A, B, C,D) which is sensitive to ultraviolet and/or visible actinic light will subsequently be referred as "recording element (A, B, C, D) as claimed in this invention." Correspondingly, the new processes for the production and further processing of the recording element (A, B, C, D) as claimed in this invention will be referred to as "production processes as claimed in this invention" and "further processing processes as claimed in this invention."

Also, the new device for carrying out the processing and further processing process will be referred to as "device as claimed in this invention." The component of the recording element (A, B, C, D) as claimed in this invention, which is essential to this invention, is the image mask (D)

which is superimposed directly onto the surface of the cover layer (C) of the recording element. This image mask (D) is a relief-like pattern of coated areas (D1) and uncoated areas (D2). The coated areas (D1) are substantially opaque to the actinic light to be used. This means that they absorb ultraviolet and/or visible light to such an extent that it is no longer able to trigger any photochemical reactions in the photosensitive recording layer (B1) and (B2) of the recording element (A, B, C, D) as claimed in this invention.

According to this invention, the coated areas (D1) of the relief-like pattern or the image mask (D) preferably consist of droplets of liquid or of solid particles which have been transferred to the surface of the cover layer (C).

The droplets of liquid or solid particles have a composition to ensure that they meet the above-mentioned requirement, namely to be substantially opaque to the actinic light that is to be used.

Thus, many different kinds of solid particles or droplets of liquid can be used to build up the coated areas (D1) of the image mask (D), provided that they have the property mentioned above.

According to this invention, however, it is preferable to use liquid toner droplets or toner particles of the type generally used in electrophotography. As is well-known, these toners consists of polymer-coated pigment particles with an average particle diameter in a range from approximately 0.05 to 100 μm, with especially fine toner particles that can be colloidally dissolved being particularly preferred by this invention. Toners of this type are described, for example, in EP-A-02 25 547, DE-A-38 21 199, or US-A-46 61 431.

For special application purposes, these toners may also contain very hard fillers of extremely small particle size. "Very hard" is defined as a value of >7 on the modified Mohs hardness scale. "Small particle size" is define as an average grain size of the filler particle of 0.5 to 40 μm. Examples of particularly well-suited filler particles of the type mentioned include pyrogenic silicic acid and quartz, zirconium, titanium nitride, tungsten carbide, tantalum carbide, zirconium carbide, aluminum oxide, titanium nitride, zirconium boride, silicon carbide, aluminum

boride, boron carbide, and diamond dust. Of these, pyrogenic silicic acid and quartz, diamond, silicon carbide, and tungsten carbide are especially recommended.

According to this invention, it is also recommended to produce the droplets of liquid or the solid particles from inks of the type used in ink-jet printing. These tints may be liquid inks which consist of components which are liquid at room temperature; however, the inks may also contain solid particles which are dissolved or dispersed in a liquid or they may be melted droplets on the basis of a synthetic material.

Both inks on the basis of liquids and melted inks are well-known and can be conventionally applied; they are also commercially available and have been described in the article "INKJET, hot ink for high-speed printers," published in the journal Der Polygraph, No. 14-89, pages 1151 to 1152. Additional ink compounds are known from DE-A-38 26 734, DE-A-38 25 007, DE-A-37 15 643, DE-A-37 15 630, DE-A-33 20 373, DE-A-31 05 525, or DE-A-31 06 208.

According to this invention, the droplets of liquid or the solid particles to be used preferably consist of melted or evaporation-coated liquid or resolidified pigments or mixtures of pigments and binders of the type used in thermal transfer printing. Examples of suitable pigments or mixtures of pigments and binders are known, for example, from DE-A-35 07 418.

Other examples of mixtures of pigments and binders or melted inks on the basis of a synthetic material suitable for use both in thermal transfer printing and for ink-jet printing are mixtures of conventional and well-known commercially available black pigments, such as carbon black or Negropac_®, and binders such as polyvinyl alcohol, styrene/maleic semiester copolymers or methylmethacrylate/methacrylic acid copolymers.

As provided by this invention, droplets of liquid or solid particles on the basis of toners /6
and inks are to be particularly preferred.

According to this invention, the droplets of liquids or the solid particles are directly superimposed onto the surface of the cover layer (C) of the recording element (A, B, C, D) as claimed in this invention. The solid particles may be glued to the surface or to each other, they

may be melted and/or chemically bonded. The chemical bonding may take place chemically by reacting the solid particles with suitable reagents, thermochemically by heating the particles and/or photochemically by exposing the particles to actinic light. In addition, to increase their opaqueness to actinic light, the solid particles may contain highly absorbent substances, such as carbon black, manganese dioxide, pigments, or metal particles, with the choice of these light-absorbent substances being mainly dependent on the wavelength of the actinic light, thus making it easy for those skilled in the art to make the appropriate choice.

Another important aspect of the recording element (A, B, C, D) as claimed in this invention is the photosensitive recording layer (B) which can be either a negative-producing layer (B1) or a positive-producing layer (B2).

As is well-known, a solubility difference between the exposed and the unexposed areas will be observed when a negative-producing photosensitive recording layer (B1) is exposed to actinic light; this allows the unexposed areas to be rinsed off with a suitable developing solvent, the solubilizing power of which is targeted to the material composition of the photosensitive recording layer (B1), while the exposed areas are not dissolved by the developing agent.

A solubility difference between the exposed and the unexposed areas will again be observed when a positive-producing photosensitive recording layer (B2) is exposed to actinic light, with the difference that in this case, the exposed areas can be rinsed off with a suitable developing solvent, the solubilizing power of which is targeted to the material composition of the photosensitive recording layer (B2), while the unexposed areas are not dissolved by the developing agent.

The negative-producing photosensitive recording layers (B1) to be used include conventional and well-known photopolymerizable or photo-cross-linkable layers.

As is well-known, the photopolymerizable photosensitive recording layers (B1) contain a minimum of one binder, a minimum of one photopolymerizable olefinically unsaturated monomer which is compatible with this binder, and a minimum of one photopolymerization initiator.

Examples of suitable polymer binders for use in these well-known negative-producing

photopolymerizable photosensitive recording layers (B1) include copolymers of ethylene with (meth)acrylic acid and vinyl esters, vinyl ethers, (meth)acrylic esters and/or (meth)acrylic amides; maleinated alkadiene polymers; alkadiene polymers which were polymer-analogously modified by means of maleination and partial esterification or partial amidation copolymers of alkadienes with α,β-olefinically unsaturated carboxylic acids; alkadiene/acrylonitrile copolymers containing carboxyl groups; partially or nearly completely hydrolyzed poly(vinyl alcohol alkanecarboxylic esters); partially or nearly completely hydrolyzed vinyl alcohol alkanecarboxylic ester/alkylene oxide graft copolymers; polyalkadienes; alkadiene/acrylonitrile copolymers; acrylate rubber; polychloroprenes; fluorinated rubber; silicone rubber; polysulfide rubber; ethylene/propylene/alkadiene copolymers; chlorosulfonated polyethylene, and linear homo- and mixed polyamides.

Examples of suitable photopolymerizable, olefinically unsaturated monomers that are compatible with binders include esters of acrylic acid and methacrylic acid; styrene and its derivatives; esters of fumaric acid and maleic acid; vinyl esters, vinyl ethers; acrylamides and methacrylamides and allyl compounds. It is especially recommended to use those monomers which have a boiling point of more than 100°C at atmospheric pressure and a molecular weight of up to 3000, especially up to 2000.

Examples of suitable photopolymerization initiators for use in negative-producing photopolymerizable, photosensitive recording layers (B1) include benzoin or benzoin derivatives; symmetrically or asymmetrically substituted benzyl acetals; acyl aryl phosphinoxides and acyl aryl phosphinic esters; substituted and unsubstituted quinones, and compounds containing trihalomethyl groups.

As is well-known, the negative-producing photo-cross-linkable photosensitive recording layers (B1) contain either

- a hydrophilic binder and a photosensitive metal salt;
- a hydrophilic binder and a tetrazonium salt of a diamino compound, such as p-aminodiphenylamine, benzidine, diamidine, or toluidine;

- a diazo resin which has been prepared substantially from formaldehyde and a diphenylamine diazonium salt;
- a hydrophilic or an alcohol-soluble binder and an azido compound;
- a rubber or other binders that are soluble in organic solvents and an azido compound;
- a compound which dimerizes when irradiated with actinic light, such as polyvinyl cinnamate; or
- a hydrophilic binder and a diazo resin which has been prepared substantially from formaldehyde and a diphenylamine diazonium salt.

The positive-producing recording layers (B2), on the other hand, contain, as is well-known, either

- an alkali-soluble binder and a quinonediazido compound, such as naphtoquinone-1,2,-diazidosulfonate ester; /7
- a compound which, when exposed to light, cleaves off acid, a monomer or polymer compound which contains a minimum of one C-O-C groups which can be cleaved off by means of acid, such as an o-carboxylic ester group or a carboxylic acid amide acetal group, and optionally a binder; or
- a compound with a minimum of two aromatic and/or heteroaromatic o-nitrocarbinol ester groups, a cross-linking compound with a minimum of two reactive groups which are able to react when heated with carboxyl groups, and a catalyst which accelerates this reaction, such as iodonium, sulfoxonium, or pyrrylium salts,

The decision as to which photosensitive recording layer (B1) or (B2) should be used and in which thickness this layer should be incorporated into a recording element (A, B, C, D) as claimed in this invention depends mainly on the intended application of the recording element (A, B, C, D) as claimed by this invention, i.e., on whether it is to be used to produce a gravure, offset, relief, or flexographic printing plate or a photoresist. The material compositions of the photosensitive recording layers (B1) or (B2) which are especially suitable for a particular application and the thickness range normally used therefor are well-known, especially to those

skilled in the art.

Another important component of the recording element (A, B, C, D) as claimed in this invention is the dimensionally stable carrier (A). The photosensitive recording layer (B1) or (B2) may be permanently bonded to this dimensionally stable carrier (A) or it may be attached in such a way that it can be readily peeled off the recording layer. Below the dimensionally stable carrier (A), a flexible underlayer may be provided. Furthermore, a separate adhesive layer between the carrier (A) and the photosensitive recording layer (B1) or (B2) can serve as the permanent bond. If the dimensionally stable carrier (A) is attached to the photosensitive recording layer (B1) or (B2) so that it can be readily peeled off, this carrier is also referred to as a temporary layer carrier (A).

The dimensionally stable carriers (A) to be used include plates, films or conical or cylindrical sleeves of metals, such as steel, aluminum, copper, or nickel, or of synthetics, such as polyethylene terephthalate, polybutylene terephthalate, polyamide or polycarbonate. In addition, woven fabrics, nonwoven materials, such as glass fabrics, or composite materials made of glass fibers and synthetics, such as polyethylene terephthalate, should be taken into consideration. In addition, plates, such as they are conventionally used in the production of circuit boards, may be used.

Another important component of the recording element (A, B, C, D) as claimed in this invention is the optically transparent cover layer (C) which contains a minimum of one polymer that forms a film which is resistant to tearing. Generally, this cover layer is 0.01 to 10 μm thick. In individual cases, the use of thicker cover layers may be desirable; however, thicker cover layers increase the risk of light scattering, which may distort the pattern in the masked-image layer (B) and render it unrecognizable. Similarly, it is not recommended to use cover layers (C) with a thickness of less than 0.01 μm since cover layers of this type no longer act reliably as a diffusion barrier and as a barrier against mechanical damage. Therefore, a thickness range from 0.01 to 10 μm is considered ideal; within this range, the thickness of the cover layer (C) may vary widely and can be readily adjusted to complement the other material and optical parameters of the recording

element (A, B, C, D) as claimed in this invention. Within this optimum range, the thickness from 0.2 to 5.0 μm should be particularly emphasized since, from the standpoint of material consumption and the diffusion barrier effect, cover layers (C) in this thickness range present particular advantages.

The cover layer (C) contains a minimum of one optically transparent polymer which forms tear-resistant films. Examples of suitable polymers of this type to be used according to this invention include polyamides, mixed polyamides, polyurethanes, poly(meth)acrylates, cyclized rubber with a high degree of cyclization, ethylene/propylene copolymers, homopolymers and copolymers of vinyl chloride, ethylene/vinyl acetate copolymers, partially or nearly completely hydrolyzed poly(vinyl alcohol alkanecarboxylic esters), partially or nearly completely hydrolyzed vinyl alcohol alkanecarboxylic ester/alkylene oxide graft copolymers, gelatins, cellulose ethers, cellulose esters, polyvinyl pyrrolidone, vinyl aromatics/alkenedicarboxylic anhydride copolymers, vinyl ether/alkenedicarboxylic anhydride copolymers, poly(meth)acrylic acid, (meth)acrylic acid/(meth)acrylate copolymers and polyalkylene oxides.

According to this invention, the highly crystalline, nearly completely hydrolyzed poly(vinyl alcohol alkanecarboxylic acid esters) and vinyl alcohol alkanecarboxylic acid ester/alkylene oxide grafted copolymers and the polyamides and the mixed polyamides offer special advantages and therefore to be preferred.

Examples of polyamides and mixed polyamides that are particularly preferred by this invention include linear homopolyamides and mixed polyamides which have been prepared according to well-known methods from bifunctional carboxylic acids and diamines or from ω-amino acids, lactams, or from suitable derivatives of these compounds, such as nylon 3, 4, 5, 6, 8, 11, 12, 13, 6.6, 6.10, or 6.13; or a polyamide from metaxylylenediamine and adipic acid or from trimethylhexamethylenediamine or isophoronediamine and adipic acid; or nylon 6/6.6, 6/6.6/6.10 or 6.6.6/6.10/6.12; or a polyamide from ε-caprolactam/adipic acid/hexamethylenediamine/4,4-diaminodicyclohexylmethane or from ε-caprolactam/adipic acid/hexamethylenediamine/polyethylene glycol diamine; or the N-methylol or N-alkoxymethyl

derivatives of all of these homo- and mixed polyamides.

Examples of nearly completely hydrolyzed poly(vinyl alcohol alkanecarboxylic acid esters) that are especially preferred by this invention include polyvinyl acetates and polyvinyl propionates with a degree of hydrolysis of 88 to 98 mol%, especially 95 to 98 mol%, which contain recurring 1-hydroxy-1,2-ethylidene units in the polymer chain. In common language usage, these polymers are also called polyvinyl alcohols. Further advantages result if these polyvinyl alcohols have mean molecular weights M of 104 to 105, especially /8
1.5 x 104 to 5 x 10 [sic].

Examples of especially recommended nearly completely hydrolyzed vinyl alcohol alkanecarboxylic acid ester/alkylene oxide grafted copolymers are those which are obtained by a graft of vinyl acetate or vinyl propionate onto polyethylene oxide and subsequent hydrolysis and which -- relative to the grafted copolymer -- consist of 10 to 30 percent by weight of 1-oxapropylidene-1,3 units, 0 to 30 percent by weight of 1-acetyl-1,2-ethylidene units, and 90 to 40 percent by weight of 1-hydroxy-1,2-ethylidene units.

In addition, the cover layer (C) may contain optically transparent flatting agents which are at least largely, but best completely inert to the other constituents of the photosensitive recording element (A, B, C, D) as claimed in this invention and which have an optical refractive index that corresponds to that of the other constituents of the cover layer (C). In this context, a special advantage arises if the refractive indices of all constituents of the cover layer (C) are nearly or exactly the same.

Examples of suitable flatting agents include organic solids of small particle size, such as polystyrene, and inorganic solids of small particle size, such as glass beads, ground quartz, and precipitated and pyrogenic silicic acid.

In addition to the polymers described above which form tear-resistant films and the optically transparent flatting agents, the cover layer (C) may also contain other additives. Examples of suitable additives include antistatic agents, flow-control agents (wetting aids), monomers, photopolymerization initiators and inhibitors of the thermally initiated polymerization.

Examples of highly suitable additives of this type are known from EP-A-03 16 618, US-A-41 62 919, DE-A-21 23 702, US-A-4 072 527 and US-A-34 53 311 or DE-A-16 22 298. If such additives are incorporated into the cover layer (C), their content should generally not exceed 20 percent by weight relative to (C).

In the recording element (A, B, C, D) as claimed in this invention, the surface of the cover layer (C) may also be slightly sticky.

The recording element (A, B, C, D) as claimed in this invention is a ready-for-sale product and can be shipped without problems in a dimensionally stable lightproof package.

The recording element (A, B, C, D) as claimed in this invention can be prepared according to any method; preferably, however, it is prepared according to the process described by this invention.

The process described by this invention is based on the preparation of the photosensitive recording layer (B1) or (B2). This preparation entails the conventional and well-known technique of mixing the components of the photosensitive recording layer (B1) or (B2) by means of conventional kneading, mixing and solution techniques and by shaping the resulting mixtures (B1) or (B2) into a sheetlike photosensitive recording layer (B1) or (B2) by pouring them from a solution, sintering them under pressure, calendering or extruding them; it is also possible to combine these processing steps in a suitable manner.

Parallel to or immediately following the preparation of this photosensitive recording layer (B1) or (B2), this layer is combined with the dimensionally stable carrier (A), optionally also using an adhesive layer and an elastic underlayer. Obviously, it is possible to carry out these processing steps in series or simultaneously to each other in conventional and well-known devices either in a continuous or in a batch operation. In all cases, the photosensitive recording layer (B1) or (B2) may be built up of sublayers (B1) or (B2) of identical, nearly identical, or different material composition, such as is described, for example, in EP-A-0,084,851 or DE-A-2,942,183 (US-A-43 20 188).

Subsequently, the cover layer (C) is applied to the surface of the photosensitive recording

layer (B) according to conventional and well-known methods. This may be accomplished, for example, by first applying the cover layer (C) in the thickness desired to the surface of a synthetic film, preferably a polyethylene terephthalate film, by pouring a solution onto the surface and by subsequently allowing it to dry. The free surface of the cover layer (C) of the resulting laminate is subsequently bonded to the surface of the photosensitive recording layer (B), and the synthetic film is peeled off the cover layer (C).

According to the process described by this invention, an image mask (D) is subsequently produced on the surface of the cover layer (C) of the photosensitive recording element (A, B, C) by applying droplets of liquid or solid or melted particles or particles dispersed or dissolved in liquids in a pattern to the surface of the cover layer and by preferably allowing the particles dispersed or dissolved in liquid to dry and the melted particles to solidify.

Although the process as claimed in this invention provides for the use of any suitable droplets of liquid or particles, the use of toners of the type used in electrophotography, inks of the type used in ink-jet printers, and pigments and/or mixtures of pigments and binders of the type used in thermal transfer printing is to be preferred. Examples of suitable toners, inks, pigments, and mixtures of pigments and binders include those described earlier.

These droplets of liquid or particles may be applied by any technique so as to produce an image on the surface of the cover layer (C) of the photosensitive recording element (A, B, C); however, the final product obtained by the process according to this invention, i.e., the recording element (A, B, C, D), offers special advantages if the toner is applied by first producing a toner image, using a substantially well-known technique, on the surface of a substantially well-known electrophotographic recording element (E) by charging this surface with a high-voltage discharge corona, by exposing it to actinic light, and by applying the toner, and finally, by transferring this toner image directly to the surface of the cover layer (C) of the photosensitive recording element (A, B, C).

To carry out the production process as claimed in this invention using the preferable technique just described, a sheetlike electrophotographic recording element (E) can be used. The

toner image produced on this element can subsequently be transferred either like a stamp onto the surface of the cover layer (C) of a sheetlike photosensitive recording element (A, B, C) or it may be absorbed by the surface of the cover layer (C) of a photosensitive recording element (A, B, C) /9
which is cylindrical in shape or which is attached to a cylinder and rolled over the toner image.

In another especially recommended variation of the production process as claimed in this invention, a cylindrical electrophotographic recording element (E) is used. The toner image produced on this element can be transferred by rolling it onto the surface of the cover layer (C) of a sheetlike photosensitive recording element (A, B, C), or it can be transferred onto the surface of a cover layer (C) of a photosensitive recording element (A, B, C) which is cylindrical in shape or which is attached to a cylinder by rotating the cylindrical electrophotographic recording element (E) in a calender-like fashion against the photosensitive recording element (A, B, C) which is cylindrical in shape or which is attached to a cylinder.

The production process as claimed in this invention, in which a cylinder-shaped electrophotographic recording element (E) and a cylinder-shaped photosensitive recording element (A, B, C) are used, deserves particular mention since it enables the production of seamless continuous-roll printing rollers for continuous gravure, offset, relief, and flexographic printing in an elegant and simple way.

Regardless of which above-mentioned type of production process as claimed in this invention is applied, it is recommended to use a computer-controlled laser light source for exposing the electrostatically charged electrophotographic recording element (E) to light.

Suitable sheetlike and cylinder-shaped electrophotographic recording elements (E) and suitable laser-light sources are known from the field of photocopying or from EP-A-01 31 215, EP-B-00 31 481, EP-A-01 50 419, EP-A-01 62 216, EP-A-01 56 308, EP-A-01 31 292, EP-A-01 52 889, EP-A-01 98 488, EP-A-02 89 056, EP-A-03 26 132, and EP-A-03 26 169, or from DE-A-34 14 791.

In another highly recommended variation of the production process as claimed in this invention, the inks are transferred onto the surface of the cover layer (C) of a photosensitive

recording element (A, B, C) by means of a computer-controlled ink-jet printer. Examples of suitable inks and suitable computer-controlled ink-jet printers are known from the article "INKJET, hot ink for high-speed printers," in the journal Der Polygraph, Volume 14 (1989), pages 1151 to 1152, the article by Oliver Bruns, "Proofs from digital data: the ink-jet printer Iris 3024 in the Response System and Scitex," in the journal Deutscher Drucker No. 36/November 9, 1989, pages w10 to w11, or in the brochure by Hewlett-Packard, "Professional Printer DeskJet PLUS, Owner's Manual," March 1989. In yet another highly recommended variation of the production process, pigments or mixtures of pigments and binders are used to produce the coated areas (D1) of the image mask (D).

A special advantage is obtained if the pigments and/or mixtures of pigments and binders are transferred from a film, which contains a pigment layer or a layer of pigments and binders, onto the surface of the cover layer (C) of the photosensitive recording element (A, B, C).

This is accomplished in a particularly beneficial manner by heating the film on the surface facing away from the pigment or pigment/binder layer by means of a computer-controlled thermal head or by means of a computer-controlled laser-light source.

In all above-mentioned variations of the production process as claimed in this invention, it is especially beneficial if the surface of the cover layer (C) of the recording element (A, B, C) used in the production process as claimed in this invention is slightly sticky.

The production process as claimed by this invention offers several especially surprising advantages.

First of all, the production process as claimed by this invention allows the transfer of digital picture information onto photosensitive recording element (A, B, C); secondly, it makes it possible to prepare the photosensitive recording elements (A, B, C, D) as claimed by this invention in a simple and safe manner. Furthermore, the production process according to this invention is extremely variable as it allows not only the production of sheetlike recording elements (A, B, C, D) as claimed by this invention in any size and shape but it also allows an especially simple and inexpensive production of recording elements (A, B, C, D) which are cylinder-shaped

or attached to a cylinder and which otherwise are difficult to produce. In addition, the production process according to this invention allows a central and therefore inexpensive and economical production of sheetlike and cylinder-shaped recording elements (A, B, C, D) as claimed in this invention according to the specifications of print shops in a production plant. The print shops simply transmit the picture information to be copied digitally to the central production plant which produces the sheetlike or cylinder-shaped recording elements (A, B, C, D) as claimed in this invention, using the production process described, and send these elements to the print shops for further processing. It is, of course, also possible for the central production plant as such to further process the sheetlike or [sic; word missing–cylinder-shaped] recording elements (A, B, C, D) as claimed by this invention and to supply the print shops with the resulting gravure, offset, relief, and flexographic printing plates. Of course, the same also applies to the production and further processing of photoresists which are used in the production of circuit boards.

Regardless of whether the production process as claimed in this invention is carried out in a central production plant, in a print shop, or in the plant of a circuit board manufacturer, the process has yet another special advantage: it is possible as early as immediately following the production of the recording elements (A, B, C, D) to see the high-contrast printed image or circuit board image. If this printed image or circuit board image has to be corrected or if the print-shop personnel or the manufacturer of circuit boards wants to make changes, it is simple to do so at any time: all that is required is to rinse off the image mask (D) with a suitable solvent which does not affect the cover layer (C) and to reapply the corrected or changed image mask (D) according to the process described by this invention.

The recording elements (A, B, C, D) as claimed by this invention and especially those /10
produced according to the production process as claimed by this invention can be subjected to any further processing techniques desired. As claimed in this invention, however, it is highly beneficial to use the process for further processing as is described by this invention.

The process as claimed in this invention for further processing of the recording elements serves to produce camera-ready gravure, offset, relief, and flexographic printing plates and

photoresists. It is based on a recording element (A, B, C, D) as claimed in this invention, which is suitable for any printing or photoresist technique. According to the technique described by this invention, the entire surface of this recording element (A, B, C, D) as claimed in this invention is directly exposed to ultraviolet and/or visible actinic light. Since the coated areas (D1) of the image masks (D) of the recording element (A, B, C, D) as claimed in this invention are substantially opaque to the actinic light used, no photochemical changes occur in those areas of the photosensitive recording layer (B1) or (B2) which are covered by the coated areas (D1). Those areas which are not screened by the image mask (D) (uncoated areas D2), on the other hand, are photochemically changed as a result of their exposure to the actinic light used, with the result that, following exposure, they have solubility properties that differ from those of the unexposed areas; this is also called solubility differentiation.

Depending on whether the recording element (A, B, C, D) as claimed in this invention has a positive-producing (B1) or a negative-producing (B2) photosensitive recording layer, either the unexposed areas (B1) or the exposed areas (B2) of the exposed recording layer (B) are rinsed off, i.e., developed, with a suitable developing solvent.

The selection of the developing solvent for the exposed recording layer (B1) or (B2) by those skilled in the art is easy and based on the material properties of the recording layer (B) concerned. Thus, an organic solvent will be suitable for nonpolar exposed recording layers (B), and polar or aqueous solvents will be suitable for polar or highly polar exposed recording layers (B).

According to this invention, a special advantage is obtained if the developing solvent concerned at the same time dissolves or at least starts to dissolve the cover layer (C), thereby removing it. Thus, the image mask (D) can be simultaneously washed off.

In the developing stage, the conventional and well-known spray washers, brush washers, or friction washers can be used. Further processing techniques as described by this invention result both in sheetlike and in cylinder-shaped camera-proof gravure, offset, relief, and flexographic printing plates and photoresists which can be used to produce circuit boards. The

developed recording layer (B) of these printing plates and photoresists contains the negative or the positive of the original digitally transmitted picture information. The special advantage of the further processing technique as described by this invention is that the printing plates and photoresists provide a detailed reproduction of the original digitally transmitted picture information on a negative or positive. As a result, the printing plates yield excellent printing results over a large number of print runs, and the defective fraction of photoresists is very small.

One of the most important advantages of the recording elements (A, B, C, D), the production process, and the technique for further processing as claimed in this invention is that it is possible to use photosensitive recording elements (A, B, C) which have a sticky surface. In contrast, in the vast majority of the state-of-the-art processes, photosensitive recording elements (A, B, C) with a sticky surface cannot be used to produce printing plates or photoresists or can only be used under highly restrictive circumstances.

The production process as claimed in this invention can be carried out using any conventional and well-known devices. It is, however, especially recommended to use the device as claimed in this invention to carry out the production process according to this invention. The device as claimed in this invention can also be designed to ensure that it can also be used to carry out the technique for further processing according to this invention.

The most important component of the device as claimed in this invention is a cylinder-shaped electrophotographic recording element (E) which comprises an electrically conductive, dimensionally stable carrier (E1) and an organic or inorganic photoconductive recording layer (E2). Examples of suitable cylinder-shaped electrophotographic recording elements (E) include, for example, those known in the field of photocopying.

Other important elements of the device as claimed in this invention include

- a minimum of one means (F) for generating a high-voltage discharge corona to electrostatically charge the cylinder-shaped electrophotographic recording element (E),
- a minimum of one means (G) for exposing the electrostatically charged photoconductive recording layer (E2) to actinic light,

- a minimum of one means (H) for applying toner to the charge image which was generated on the electrostatically charged photoconductive recording layer (E2) by means of exposure,
- a minimum of one means (I) for transferring the toner image to another surface, and
- a minimum of one means (J) for the controlled rotation of the electrophotographic recording element (E).

These components (E) through (J) and their interaction are known from the field of photocopying.

The device according to this invention, however, also comprises a minimum of one of the recording elements (A, B, C) described earlier, which may be sheetlike, cylinder-shaped, or attached to cylinders and which are sensitive to ultraviolet and/or visible actinic light. /11

It is essential to the device as claimed in this invention and to its function that the photosensitive recording element (A, B, C), which may be sheetlike, cylindrical or attached to cylinders, is in direct contact with the cylinder-shaped electrophotographic recording element (E) and that it can be rotated relative to this recording element at a corresponding relative speed.
The production process as claimed in this invention is carried out by means of the device as claimed in this invention as follows: First, a toner image is produced by conventional and well-known means on the rotating cylinder-shaped electrophotographic recording element (E). This toner image is transferred to the recording element at the point at which the toner-coated cylinder-shaped electrophotographic recording element (E) comes into contact with the photosensitive recording element (A, B, C). As the cylinder-shaped electrophotographic recording element (E) continues to rotate, its surface is freed from potentially adhering toner residues, thus readying it for a new imaging cycle.

As to the device as well as the production cycle as claimed in this invention, it is especially useful if the device contains a minimum of one means (K) for removing any excessive toner, which may still be present after the image has been transferred, from the surface of the cylinder-shaped electrophotographic recording element (E) and/or a minimum of one means (L) for ensuring a controlled movement of the photosensitive recording element (A, B, C) which may

be sheetlike or cylinder-shaped or attached to cylinders.

A special advantage is obtained if the claimed device for the production process as claimed in this invention is fitted with a cylinder-shaped photosensitive recording element (A, B, C) which is rotated relative to the cylinder-shaped electrophotographic recording element (E) in a calender-like fashion. This particularly beneficial design of the device according to this invention ensures an especially accurate and rapid transfer of the toner image from the cylinder-shaped electrophotographic recording element (E) onto the cylinder-shaped photosensitive recording element (A, B, C).

In another especially useful variation of the device as claimed in this invention, the sheetlike photosensitive recording element (A, B, C) passes in the form of an endless band by the cylinder-shaped electrophotographic recording element (E) which transfers its toner image continuously onto the bandlike photosensitive recording element (A, B, C).

To carry out the technique for further processing of the recording element, the device as claimed in this invention, in addition to the elements (E) through (L), may also contain the following means:

- a minimum of one means (M) for exposing the entire surface of the claimed recording element (A, B, C, D), which was produced by means of the device as claimed in this invention, to actinic light,
- a minimum of one means (N) for washing off the exposed or unexposed areas, the cover layer (C), and the image mask (D) of the claimed recording device (A, B, C, D) which was subjected to full-surface exposure,
- a minimum of one means (O) for drying the washed recording device (A, B, C, D) as claimed in this invention, and/or
- a minimum of one means (P) which serves to guide the photosensitive recording element (A, B, C) to the cylinder-shaped electrophotographic recording element (E) and to transport the recording element (A, B, C, D) as claimed in this invention away from it.

In all cases, it is highly beneficial if the device as claimed in this invention contains a

computer-controlled laser-light source as means (G).

It is also of benefit to the device as claimed in this invention if the surface of the cover layer (C) of the photosensitive recording element (A, B, C) used is sticky. Due to this considerable advantage, it is no longer necessary to remove the adhesive layer from the surface of photosensitive recording elements (A, B, C). As a result of its special advantages, the device a claimed in this invention is particularly suitable for the production of seamless gravure, offset, relief, and flexographic printing rollers for use in continuous roll printing. In addition, it is, of course, possible to continuously produce sheetlike recording elements (A, B, C, D) as claimed in this invention as well as products subsequently manufactured from these recording elements, which can then be dimensioned to fit each particular application. Thus, the device as claimed in this invention makes it possible, for example, to produce continuous photoresist webs which can be visually inspected prior to final processing and cut to the size desired. This further reduces the defective fraction of the production process and subsequent treatment as claimed in this invention, which is low to begin with. Overall, the device as claimed in this invention provides for fast, safe, and accurate transmission of digital picture information to a large number of very different recording element (A, B, C). The claimed device is therefore very versatile.

Examples and reference examples

Examples 1 through 10 and Reference Examples V1 through V10

The production of recording elements (A, B, C, D) as claimed in this invention and subsequent treatment processes described by this invention to obtain printing plates (Examples 1 through 10) compared to the subsequent pre-invention treatment of conventional recording elements (A, B, C) to produce printing plates (Reference Examples V1 through V 10).

General test specifications

For Examples 1 through 10 and Reference Examples V1 through V10, the photosensitive recording elements (A, B, C)-1 to -10 listed in the table were used. The table provides information on the structural composition of the substantially known photosensitive recording elements (A, B, C), the thickness, and the material composition of the photosensitive recording layers (B) and the type of image reproduction (negative-producing: B1; positive-producing: B2) and on the use to which the printing plates produced from these recording elements (A, B, C) are generally are put. For this purpose, /12

- the cover layers (C) used in Examples 1 through 3 and 10 and in Reference Examples V1 through V3 and V10 were made of the polyvinyl alcohol Mowiolλ 04-M1 of the firm of Hoechst, and
- the cover layers (C) used in Examples 4 through 9 and in Reference Examples V4 through V9 were made of the polyamide Makromelt® 9000 of the firm of Henkel. The cover layers were approximately 2 μm thick.

Table. Structural and material composition and application purpose of the photosensitive recording elements (A, B, C) used

Key:

1 Recording Element No. (A, B, C)-
2 Composition:
Carrier (A)
3 Type and thickness (μm)
4 Recording layer (B): Composition
5 Wt%
6 Type and thickness (μm)
7 Application purpose (used in Example No. and Reference Example No.)
8 Steel plate with adhesive layer (240)
9 Partially hydrolyzed polyvinyl acetate (saponification value: 88%), esterified with 3% methacrylic acid
10 Gravure printing (1, V1)
11 Of an aliphatic epoxyacrylate of formula
12 Quartz powder (with 95% of the particles smaller than 5 μm and 50% of the particles smaller than 2 μm; for this purpose, Silbond® 800 AST of the firm of Quarzwerke Frechen was used) treated with aminosilane
13 Benzyldimethylacetal
14 Potassium salt of N-nitrosocyclohexylhydroxylamine
15 Safranin T (C. I. 50,240)
16 Carrier as in (A, B, C)-1
17 Composition as in (A, B, C)-1, except that the aliphatic epoxyacrylate was replaced with the same quantity (35.27) of dicyclopentadienyldiacrylate)
18 Gravure printing (2, V2)

//insert table, p. 14//

Key:
1 Recording Element No. (A, B, C)-
2 Composition: Carrier (A)
3 Type and thickness (μm)
4 Recording layer (B): Composition
5 Wt%
6 Type and thickness (μm)
7 Application purpose (used in Example No. and Reference Example No.)
8 Carrier as in (A, B, C)-1
9 Composition as in (A, B, C)-1, except that the aliphatic epoxyacrylate was replaced with the same quantity (35.27) of the reaction product obtained from 3,4-epoxycyclohexylmethy-3',4'-epoxycyclohexanecarboxylate and methacrylic acid in a molar ratio of 1:2.2
10 Gravure printing (3, V3)
11 Carrier as in (A, B, C)-1
12 Mixed polyamide consisting of approximately identical portions of hexamethylenediammonium adipate, 4,4'-diammonium dicyclohexylmethane adipate and ε-caprolactam
13 Gravure printing (4, V4)
14 Of epoxyacrylate of formula
15 Of quartz powder according to (A, B)-1
16 Benzyldimethylacetal
17 Potassium salt of N-nitrosocyclohexylhydroxylamine
18 Safranin T (C. I. 50,240)

//insert table, p. 15//

Key:

1 Recording Element No. (A, B, C)-
2 Composition: Carrier (A)
3 Type and thickness (μm)
4 Recording layer (B): Composition
5 Wt%
6 Type and thickness (μm)
7 Application purpose (used in Example No. and Reference Example No.)
8 Carrier as in (A, B, C)-1
9 Of the mixed polyamide according to (A, B, C)-4
10 Relief printing (5, V5)
11 Penterythrite triglycidyl ether triacrylate
12 Phenyl glycidyl ether acrylate
13 Soybean lecithin
14 Benzyldimethylacetal
15 Potassium salt of N-nitrosocyclohexylhydroxylamine
16 Polyethylene terephthalate film coated with a polyurethane adhesive layer (125)
17 Three-block rubber of styrene/isoprene/butadiene according to EP-A-00 27 612, Example 2
18 Flexographic printing (6, V6)
19 Paraffin oil
20 Hexane-1,6-diol diacrylate
21 Benzyldimethylacetal
22 2,6-Di-tert-butyl-p-cresol
23 Solvent Black (C. I. 25,150)
24 Carrier as in (A, B, C)-6
25 Of the three-block rubber according to (A, B, C,)-6
26 Flexographic printing
27 Hexane-1,6-diol diacrylate
28 Benzyldimethylacetal
29 2,6-Di-tert-butyl-p-cresol
30 Solvent Black (C. I. 26,150)

//insert table, p. 16//

Key:
1 Recording Element No. (A, B, C)-
2 Composition: Carrier (A)
3 Type and thickness (μm)
4 Recording layer (B): Composition
5 Wt%
6 Type and thickness (μm)
7 Application purpose (used in Example No. and Reference Example No.)
8 Carrier as in (A, B, C)-6
9 Of a terpolymer of ethylene/propylene/ethylidene norbornene (ethylene content: 50%; 8 double bonds per 1000 carbon atoms)
10 Flexographic printing (8, V8)
11 Dioctyl adipate
12 Dihydrocyclopentadienyl acrylate
13 Isobornyl acrylate
14 Benzyldimethylacetal
15 Carrier as in (A, B, C)-1
16 Of the mixed polyamide according to (A, B, C)-4
17 Gravure printing (9, V9)
18 Of the diether of 1 mole of ethyleneglycol and 2 moles of N-methylolacrylamide
19 Benzyldimethylacetal
20 Of the quartz powder Silbond® type F 600 of the firm of Quarzwerke Frechen
21 Carrier as in (A, B, C)-1
22 Novolak resin of phenol and formaldehyde
23 Gravure printing (10, V10)
24 o-Naphthoquinone diazide-5-sulfonic acid
25 Victoria blue (C. I. 44,045)
26 2-Trichloromethyl-5-[(2'-benzyofuryl)vinyl]-1,3,4-oxadiazole
27 Glutaric anhydride

The photosensitive recording elements (A, B, C)-1 to (A, B, C)-10 were mounted on suitably dimensioned printing rollers; subsequently, an image mask (D) of coated (D1) and uncoated (D2) areas was applied. Prior to being mounted on the printing roller, the entire surface of the elements (A, B, C)-6 to (A, B, C)-8 was pre-exposed from the reverse side, i.e., through the carrier (A), to actinic light for 2 minutes. /17

To carry out Examples 1 through 4 and 9 and 10, a raster scan typical for gravure printing was developed as test image on a graphic computer by means of a graphic program and stored for the purpose of transferring it to the photosensitive recording elements (A, B, C)-1 through (A, B, C)-4 and (A, B, C)-9 and (A, B, C)-10.

Similarly, to carry out Example 5, the pattern of the well-known FOGRA [= Deutsche Gesellschaft für Forschung im graphischen Gewerbe = German Association for Research in the Printing Industry] precision test strip for PMS-Z newspaper printing was stored in a graphic computer for transfer to the photosensitive recording element (A, B, C)-5.

To carry out Examples 6 through 8, a reproduction image typical for flexographic printing was developed by means of a graphics program and stored in the graphics computer for the purpose of transferring it onto the photosensitive recording elements (A, B, C,)-6 through (A, B, C)-8.

The transfer of the digital picture information, i.e., the production of the image mask (D) on the photosensitive recording layers (B1) or (B2) of the photosensitive recording elements (A, B, C)-1, -4, and -6, using the ink-jet printing technique (Examples 1, 4, and 6) was carried out by means of an ink-jet printer by IBM, which was controlled by a graphics computer, in which the ink used contained a mixture of 20 percent by weight of carbon black pigment and 80 percent by weight of polyvinyl alcohol, relative to the mixture.

Following the ink application, the ink images or the image masks (D) on the photosensitive recording elements (A, B, C, D) as claimed by this invention were allowed to dry.

To transfer the digital image information, i.e., to produce the image mask (D) on the photosensitive recording elements (A, B, C)-2, -5, -8, and -9, by means of electrophotography

(Examples 2, 5, 8, and 9), a conventional and well-known photocopying roller (cylinder-shaped electrophotographic recording element E) was electrostatically charged, using a conventional and well-known technique, and exposed to light while the roller was rotated by means of a computer-controlled helium/neon laser (wavelength of the main emission: 633 nm), thus producing an image. At a scanning point frequency of 3.8 MHz, the printing speed was 193 m x s^{-1}, which, at a feed in 27 μm steps, corresponded to an exposed area of 42 cm^{-2} x s^{-1}. Following exposure, a solid toner of small particle size (carbon black pigment dispersed in a thermoplastic substance) was applied to the resulting charge images, using conventional and well-known techniques. The resulting toner image was subsequently transferred to the photosensitive recording elements (A, B)-2, -5, -8, and -9 by rotating one element each and the toner-coated photocopying roller at a synchronized speed against each other in a calender-like fashion. Following the transfer of the toner image, remaining toner particles were removed from the photocopying roller which was subsequently used for further digital information transfers.

To transfer the digital picture information, i.e., to produce the image mask (D) on the photosensitive recording elements (A, B, C)-3 and -7, by means of thermal transfer printing (Examples 3 and 7), a 4 μm thick polyester film, the back surface of which was coated by evaporation with a 200 nm thick tin layer. This polyester film was covered with a 1 μm thick layer of carbon black pigment, pyrogenic silicic acid, and polyvinyl alcohol (mixture of pigments and binders). The transfer film was inserted into a computer-controlled thermal transfer printer between a thermal head line and the elements (A, B, C)-3 and -7. By successively and electronically triggering the thermal line and by advancing the transfer film and the element (A, B, C), the digital information was transferred line by line.

All of the recording elements (A, B, C, D) as claimed in this invention, which were obtained by means of the claimed process, of Examples 1 through 10 contained an image mask (D) which was in excellent contrast with the cover layer (C). It would therefore have been easy to recognize and correct potential transfer errors; however, no such errors were present, thus making it possible to continue processing the recording elements (A, B, C, D) to produce printing

plates.

For this purpose, the entire surface of the claimed recording elements (A, B, C, D) of Examples 1 through 10 was exposed to light, using conventional and well-known UV fluorescent tubes. In Examples 1 through 4 and in Examples 9 and 10, the exposure time was within the range normally used to expose photosensitive recording elements (A, B, C) which are used to produce gravure printing plates (0.5 to 1 min). In Example 5, the exposure time used was within the range normally used to expose photosensitive recording elements (A, B, C) which serve to produce relief printing plates (0.5 to 2 min). In Examples 6 through 8, the exposure time was within the range normally used to expose photosensitive recording elements (A, B, C) which serve to produce flexographic printing plates (10 to 20 min).

Following exposure, the claimed recording elements (A, B, C, D) of Examples 1 through 10 were developed with suitable developing solvents. The following developing solvents were used:

- In Examples 1 through 3 (elements (A, B, C, D)-1, -2, and -3), water was used;
- in Examples 4, 5, and 9 (elements (A, B, C, D)-4, -5, and -9), a mixture of n-butanol and water in a proportion by volume of 80 to 20 was used;
- in Examples 6 through 8 (elements (A, B, C, D)-6, -7, and -8), a mixture of Shellsol D 60, a mineral spirit of the firm of Esso, and Exxate 700, a technical ester mixture of the firm of Exxon, was used in a proportion by volume of 80 to 20;
- in Example 10 (element (A, B, C, D)-10), 1% aqueous sodium hydroxide solution was used.

To develop the claimed recording elements (A, B, C, D), which had been subjected to full-surface exposure, with the above-mentioned developing solvents, the following devices were used: /18

- In Examples 1 through 4 and in Examples 9 and 10, conventional and well-known nyloprint® rinsing apparatuses suitable for the production of gravure printing plates were used;
- in Example 5, the conventional and well-known nyloprint® rinsing apparatus suitable for the production of relief printing plates was used; and

- in Examples 6 through 8, the conventional and well-known nyloflex® FIII rinsing apparatuses suitable for the production of flexographic printing plates were used.

In the Reference Examples V1 through V4 and V9 and V10, a raster image film typically used in gravure printing was used as a model, the pattern of which corresponded exactly to the computer graphics which had been developed and stored for carrying out Examples 1 through 4 and Examples 9 and 10.

In Reference Example V5, the well-known FOGRA precision test strip for PMS-Z newspaper printing was used as a model. The model used in Reference Examples V6 to V8 was a negative film typical for flexographic printing, the pattern of which corresponded exactly to the computer graphics which had been developed and stored to carry out Examples 6 through 8.

Prior to use, the entire surface of the conventional elements (A, B, C)-6 to -8 (Reference Examples V6 to V8) was pre-exposed from the reverse side, i.e., through the carrier (A), to actinic light for 2 minutes, using conventional and well-known techniques.

To carry out the Reference Examples V1 through V10, the ten conventional recording elements (A, B, C)-1 through -10 were mounted on printing rollers with a suitable diameter and subsequently exposed by means of the films mentioned above by intimately pressing the films or image masks (D) with a transparent film, which covered approximately one tenth of the circumference of the roller, onto the element and by subsequently advancing these films and image masks, with the area of contact pressure being exposed to actinic light.

Following exposure, the conventional recording elements (A, B, C)-1 through -10 were developed with

- water (Reference Examples V1 through V3)
- a mixture of n-butanol and water in a proportion by volume of 80 to 20 (Reference Examples V4, V5, and V9),
- a mixture of Shellsol D 60, a mineral spirit of the firm of Esso, and Exxate 700, a technical ester mixture of the firm of Exxon, and 2-ethylhexanol in a proportion by volume of 60 to 20 to 20 (Reference Examples V6 through V8), and

- 1% aqueous sodium hydroxide solution (Reference Examples V10), using the rinsing apparatus mentioned above.

Following the development, the claimed gravure, relief, and flexographic printing plates were dried using conventional and well-known techniques; in the case of the flexographic printing plates (Examples 6 through 8 and Reference Examples V6 through V8), the entire surface of the plates was again exposed to actinic light.

A comparison of the claimed production and subsequent treatment processes of Examples 1 through 10 to the conventional and known processes used in Reference Examples V1 through V10 shows that the processes as claimed in this invention are more versatile, more elegant, more económical, faster, and, in addition, more accurate than the conventionally used processes. Thus, it is no longer necessary to apply only nonsticky cover layers (C) onto the surface of photosensitive recording layers (B) -- on the contrary, in the processes as claimed in this invention, the surface stickiness offers considerable benefits. In addition, the image patterns can be developed directly in the graphic computer and can be subsequently transmitted to the print shop or the plate maker via data lines, where they are directly transformed into camera-ready products, without the intermediate production of a film. The process as claimed in this invention can be carried out with recording elements (A, B, C) which may be present in the form of sheets or cylinders or which may be attached on cylinders; this is an advantage which further increases the excellent versatility of the production and subsequent treatment processes as claimed in this invention.

The special advantages of this invention are particularly obvious in the claimed recording elements (A, B, C, D). These recording elements not only have a nearly or completely error-free image-mask (D) which corresponds exactly to the computer graphics; due to the optical contrast between the image mask (D) and the cover layers (C), they also offer the possibility of a timely correction of potentially occurring transmission errors.

The special advantages of this invention, however, manifest themselves best in the gravure, relief, and flexographic printing plates which are produced from the claimed recording

elements (A, B, C, D); this is confirmed by a comparison with gravure, relief, and flexographic printing plates which were produced according to conventional and known techniques.

The last column of the table above indicates which examples and which reference tests can be directly compared.

This comparison leads to the following conclusions:

1. While the gravure printing plates produced by means of the process according to this /19
invention from the claimed recording elements (A, B, C, D)-1 through -4 and -9 and -10 accurately reproduce the computer graphics, have an excellent and smooth surface and do not scum during printing on a conventional and known gravure printer, have very good color-transfer properties, develop approximately 20 scratches per hour, and have a copying stability (determined according to the AT2 test by means of the standard abrasion tester of the firm of Schröder, D-6940 Weinheim, Federal Republic of Germany) of approximately 2 million copies, the gravure printing plates of the References Examples V1 through V4 and V9 and V10 which were produced by conventional and well-known techniques leave much to be desired: The gravure printing plates of the reference tests do not reproduce the pattern of the model image as well as the gravure printing plates of the examples (see Table), their surface is relatively rough, and during printing, these plates tend to scum, the color-transfer properties are of mediocre quality, they develop approximately 130 to 150 scratches per hour, and they have a copying stability (which was determined in the same way as that in the examples) of 150,000, which is considerably below the copying stability of 2 million as determined in the example.

2. A similar difference in quality can also be identified on the basis of a comparison of the relief printing plate, which was produced according to the process as claimed in this invention from the claimed recording element (A, B, C, D)-5, to the relief printing plate of Reference Example V5: While the relief printing plate of Example 5 (see Table) produces excellent newspaper prints at a particularly large print run, the quality of reproduction of the reference printing plate leaves much to be desired, resulting in newspaper prints of only adequate quality.

3. The same applies to the flexographic printing plates of the Reference Examples V6

through V8, the reproduction quality and copying stability of which are noticeably inferior to those seen in the flexographic printing plates of Examples 6 through 8 (see Table) which were produced according to the process claimed by this invention from the claimed recording elements (A, B, C, D)-6 through -8.

Claims

1. Recording element which is sensitive to ultraviolet and/or visible actinic light and which contains

A) a dimensionally stable carrier,

B) a negative-producing or a positive-producing photosensitive recording layer (B1) or (B2),

C) an optically transparent cover layer which contains a minimum of one polymer that forms a tear-resistant film, and

D) an image mask which is directly superimposed onto the surface of the photosensitive cover layer (C),

characterized by the fact that the image mask (D) constitutes a relief-like pattern of coated areas (D1) and uncoated areas (D2), with the coated areas (D1) being substantially opaque to the actinic light to be used.

2. Photosensitive recording element (A, B, C, D) as claimed in Claim 1, characterized by the fact that the coated areas (D1) of the relief-like pattern or of the image mask (D) consist of droplets of liquid or of solid particles which have been transferred to the surface of the cover layer (C).

3. Photosensitive recording element (A, B, C, D) as claimed in Claim 1 or 2, characterized by the fact that the droplets of liquid and the solid particles used are transferred droplets of toner fluid or solid toner particles of the type used in electrophotography, transferred ink droplets, or dried or resolidified solid ink particles of the type produced by ink-jet printers, or liquid or resolidified pigment droplets or droplets and particles of a mixture of pigments and binders which were applied by evaporation or by melting, such as are produced by means of thermal transfer

printing techniques.

4. Photosensitive recording element (A, B, C, D) as claimed in one of Claims 1 through 3, characterized by the fact that it contains a negative-producing photo-cross-linkable photosensitive recording layer (B1), a negative-producing photopolymerizable photosensitive recording layer (B1), or a photodegradable positive-producing photosensitive recording layer (B2).

5. Photosensitive recording element (A, B, C, D) as claimed in one of Claims 1 through 3, characterized by the fact that the polymers used to form tear-resistant films are polyamides, mixed polyamides, polyurethanes, poly(meth)acrylates, cyclized rubber with a high degree of cyclization, ethylene/propylene copolymers, homo- and copolymers of vinyl chloride, ethylene/vinyl acetate copolymers, partially or nearly completely hydrolyzed poly(vinyl alcohol alkanecarboxylic acid esters), partially or nearly completely hydrolyzed vinyl alcohol alkanecarboxylic acid ester/alkylene oxide grafted copolymers, gelatins, cellulose ethers, cellulose esters, polyvinylpyrrolidone, vinyl aromatic hydrocarbon/alkenedicarboxylic anhydride copolymers, vinyl alkenedicarboxylic anhydride copolymers, poly(meth)acrylic acid, (meth)acrylic acid/(meth)acrylate copolymers and/or polyalkylene oxides.

6. Ready-for-sale product, comprising a minimum of one photosensitive recording element (A, B, C, D) as claimed in one of Claims 1 through 4 in an opaque, dimensionally stable package.

7. Use of toners of the type used in electrophotography, inks of the type used in ink-jet printers, and vaporizable and/or meltable pigments and/or mixtures of pigments and binders of the type used in thermal transfer printing to produce photosensitive recording elements.

8. Process for the production of a photosensitive recording element which comprises

A) a dimensionally stable carrier, /20

B) a negative-producing or a positive-producing recording layer (B1) or (B2) which is sensitive to ultraviolet and/or visible actinic light,

C) an optically transparent cover layer which contains a minimum of one polymer which forms a tear-resistant film, and

D) an image mask which is directly superimposed onto the surface of the cover layer (C),

by placing the image mask (D) on the surface of the cover layer (C), characterized by the fact that the image mask constitutes a relief-like pattern of coated areas (D1) and uncoated areas (D2), with the coated areas (D1) being substantially opaque to the actinic light to be used.

9. Process according to Claim 8, characterized by the fact that the image mask (D) is directly produced by applying droplets of liquid or solid melted particles or particles dispersed or dissolved in liquids, with the particles which are dispersed or dissolved in liquids being allowed to dry after application and with the melted particles being allowed to solidify after application.

10. Process for the production of printing plates and photoresists from photosensitive recording elements, which comprise

A) a dimensionally stable carrier,

B) a negative-producing or a positive-producing photosensitive recording layer (B1) or (B2) which is sensitive to ultraviolet and/or visible actinic light,

C) an optically transparent cover layer which contains a minimum of one polymer which forms a tear-resistant film, by

1) superimposing an image mask (D) onto the surface of the cover layer (C),

2) by exposing the resulting photosensitive recording element (A, B, C, D) to actinic light to produce an image, and

3) by rinsing off (developing) the exposed recording element with a developing solvent, in the course of which the cover layer (C) and the unexposed areas of the recording layer (B1) or the exposed areas of the recording layer (B2) are washed off,

characterized by the fact that the image mask (D) constitutes a relief-like pattern of coated areas (D1) and uncoated areas (D2), the coated areas (D1) of which are substantially opaque to the actinic light used.

11. Process as claimed in Claim 10, characterized by the fact that the image mask (D) is directly produced by applying droplets of liquid or solid or melted particles or particles dispersed or dissolved in liquids, with the particles which were dissolved or dispersed in liquids being allowed to dry after application and the melted particles being allowed to solidify after application.

12. Process as claimed in Claim 9 or 10, characterized by the fact that the droplets of liquid and the solid or melted particles or the particles dissolved or dispersed in liquids consist of

i) toners of the type used in electrophotography,

ii) inks of the type used in ink-jet printers, or

iii) pigments and/or mixtures of pigments and binders of
the type used on thermal transfer printing.

13. Process as claimed in Claim 12, characterized by the fact that a toner image consisting of droplets of liquid toner or toner particles is produced by substantially well-known means on the surface of an electrophotographic recording element (E) by charging it with a high-voltage discharge corona, by exposing it to actinic light and by applying toner to it, and by subsequently transferring this toner image directly to the surface of the cover layer (C) of the photosensitive recording element (A, B, C).

14. Process according to Claim 13, characterized by the fact that a sheetlike electrophotographic recording element (E) is used and that the toner image produced thereon is either transferred in a stamplike fashion to the surface of the cover layer (C) of the sheetlike photosensitive recording element (A, B, C) or is absorbed by the surface of the cover layer (C) of a photosensitive recording element (A, B, C) which is cylinder-shaped or attached to a cylinder and which is rolled over the toner image.

15. Process as claimed in Claim 13, characterized by the fact that a cylinder-shaped electrophotographic recording element (E) is used and that the toner image produced thereon is either transferred by rolling it onto the surface of the cover layer (C) of a sheetlike photosensitive recording element (A, B, C) or onto the surface of the cover layer (C) of a photosensitive recording element (A, B, C) which is cylinder-shaped or attached to a cylinder, by rotating the cylinder-shaped electrophotographic recording element (E) and the photosensitive recording element (A, B, C), which may be cylinder-shaped or attached to a cylinder, in the manner of a calender against each other.

16. Process as claimed in one of Claims 13 through 15, characterized by the fact that the

electrophotographic recording element (E) is exposed to light by means of a computer-controlled laser-light source.

17. Process as claimed in Claim 12, characterized by the fact that

ii) the droplets of liquid and the melted particles and the particles dispersed or dissolved in liquids or the inks are transferred by means of computer-controlled ink-jet printers and

iii) the droplets of pigments and/or the droplets or particles consisting of pigments and binders are /21
transferred from a film, which contains a layer of pigments of a layer of pigments and binders and which is heated from the side facing away from the layer of pigments or layer of pigments and binders by means of a computer-controlled thermal head or by means of a computer-controlled laser-light source, to the surface of the cover layer (C) of the photosensitive recording element (A, B, C).

18. Device for carrying out the process as claimed in one of Claims 8 through 13 and 15 and 16, which comprises

E) a cylinder-shaped electrophotographic recording element with

E1) an electrically conductive dimensionally stable carrier, and

E2) an organic or inorganic photoconductive recording layer,

F) a minimum of one means for generating a high-voltage discharge corona for electrostatically charging the cylinder-shaped electrophotographic recording element (E),

G) a minimum of one device for exposing the electrostatically charged photoconductive recording layer (E2) to actinic light to produce an image,

H) a minimum of one means for applying toner to the charge image which was produced on the electrostatically charged photoconductive recording layer (E2) by means of exposure to light,

I) a minimum of one means for transferring the toner image to another surface, and

J) a minimum of one means for ensuring the controlled rotation of the cylinder-shaped electrophotographic recording element (E),

characterized by the fact that the device also contains a minimum of one recording element (A, B, C) which may be sheetlike, cylinder-shaped or attached to a cylinder and which is sensitive to

ultraviolet and/or visible actinic light, with

A) a dimensionally stable carrier,

B) a negative-producing or a positive-producing photosensitive recording layer (B1) or (B2), and

C) an optically transparent cover layer which contains a minimum of one polymer which forms a tear-resistant film, which recording element (A, B, C) is in direct contact with the cylinder-shaped electrophotographic recording element (E) and which can be rotated against this recording element (E) at a synchronized relative speed.

19. Device as claimed in Claim 18, characterized by the fact that it also contains

K) a minimum of one means for removing any excess toner, that may potentially remain after the transfer of the toner image, from the surface of the cylinder-shaped electrophotographic recording element (E),

L) a minimum of one means for ensuring a controlled movement of the cylinder-shaped or sheetlike photosensitive recording element (A, B, C),

M) a minimum of one means for exposing the entire surface of the photosensitive recording element (A, B, C, D), to which toner was applied to produce an image, to actinic light,

N) a minimum of one means for washing off the exposed or unexposed areas of the recording layer (B1) or (B2) of the recording element (A, B, C, D), the entire surface of which had been exposed to light and to which toner had been applied to produce an image,

O) a minimum of one means for drying the washed recording element (A, B, C, D) and/or

P) a minimum of one means which serves to guide the photosensitive recording element (A, B, C) to the electrophotographic recording element and to transport the photosensitive recording element (A, B, C, D) away from the electrophotographic recording element (E).

20. Device as claimed in Claim 18 or 19, characterized by the fact that the photosensitive recording element (A, B, C) which is cylinder-shaped or attached to a cylinder and the cylinder-shaped electrophotographic recording element (E) are rotated against each other in a calender-like fashion.

21. Device as claimed in one of Claims 18 through 20, characterized by the fact that the

device (G) is a computer-controlled laser-light source.

22. Use of the device as claimed in one of Claims 18 through 21 to produce seamless gravure, offset, relief, and flexographic printing rollers for use in continuous printing processes.